

# Theory of field-gradient NMR diffusometry of polymer segment displacements in the tube-reptation model

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## Abstract

The spin-echo attenuation in NMR field-gradient diffusometry experiments is treated for the tube model in a time scale longer than the entanglement time  $\tau_e$ . The theory comprises the Doi-Edwards [M. Doi and S. F. Edwards, *The Theory of Polymer Dynamics* (Clarendon, Oxford, 1986)] limits of the (anomalous) segment displacement as well as the (ordinary) center-of-mass diffusion. This formalism is to be distinguished from formalisms for anomalous diffusion on fractal networks: The reptation mechanism implies an intrinsically different character of the displacement probability density. It is shown that the expressions usually applied in NMR diffusometry are inadequate for the reptation problem and can cause misinterpretations. Applications of the formalism to polymer chains in bulk and confined in porous media are discussed. © 1995 The American Physical Society.

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